

# **WATER MAIN SYSTEM**

## **STANDARDS & SPECIFICATIONS MANUAL**



### **MOORE COUNTY PUBLIC WORKS**

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## **PREFACE**

These standards are for design and construction of water distribution facilities which will come under the jurisdiction of Moore County Public Works (MCPW). **These standards alone do not constitute a complete set of construction documents. The owner's or developer's Professional Engineer is responsible for design and compilation of complete construction and contract documents.** These standards are set forth as the minimal requirements to achieve a suitable quality level for utilities which will become the property of MCPW.

The standards do not include a complete commentary on methods of installation and detailed information or quality of workmanship in place. The owner's or developer's Professional Engineer must include detailed information on methods of construction and should expand on the testing and any of the special requirements to the engineer's satisfaction, subject to the approval of MCPW.

From time to time, these standards will be amended and/or expanded at the request of the MCPW Engineering Division with approval of the Director. It will be the responsibility of the owner or developer to contact the MCPW to obtain updated standards.

There may be circumstances whereby the design engineer may wish to propose changes or modifications to these standards, when this occurs permission from the County Engineer shall be obtained prior to submission to NCDENR.

## **DISCLAIMER**

To the best of their ability, the authors have insured that material presented in this manual is accurate and reliable. The design of engineered facilities, however, requires considerable judgment on the part of the designer. It is the responsibility of the design professional to insure that techniques utilized are appropriate for a given situation. Therefore, neither Moore County Public Works, nor any author or other individual, group, etc., associated with production of this manual, accepts any responsibility for improper design, any loss, damage, or injury as a result of the use of this manual.

**MANUAL 3**  
**WATER MAIN SYSTEM**  
**STANDARDS AND SPECIFICATIONS**

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# **MOORE COUNTY PUBLIC WORKS ENGINEERING DIVISION**

## **MANUAL 3 – WATER MAIN SYSTEM STANDARDS AND SPECIFICATIONS**

### **3.01 DESIGN**

#### **A. General**

Moore County Public Works (MCPW) distribution system design and construction shall be in accordance with the requirements of Title 15A 18C, .0900 “Distribution System” of the North Carolina Administrative Code, Department of Environment and Natural Resources.

#### **B. Size of Mains**

Water mains shall be sized to provide a minimum system pressure of 20 psi and minimum Residue pressure of 20 psi at all points of the distribution system during a fire flow condition with peak system demands and at least 30 psi at all points under Average Daily Demand conditions. If higher pressures are required, it is the responsibility of the water customer to provide the necessary booster pumping equipment and facilities. If booster pumps are required on the fire suppression system, the designer shall contact the County Engineer to determine the additional requirements (back-flow, etc.) that will apply. The booster pumps should be clearly noted on the construction plans if they are required. Pressure reducers, if needed, are also provided at the customer’s expense.

- (1) The C-factor to be used shall be C=120 –DIP, 150-HDPE and 130-PVC. Pipe Flow velocities shall be limited to a maximum of 10 fps under design flow conditions. The Engineer may require design conditions to be met with higher pipe velocities and/or pipe segment head losses on a case-by-case basis.
- (2) The design shall include:
  - a. Fire Flow Demand.
  - b. Any other background flow that will contribute to demand on the main.

- (3) For projects designed with more than one phase, the design analysis shall check each phase to ensure that these guidelines are satisfied during each phase of construction as well as after final completion of all phases.
- (4) The size of main to be installed shall be based on the existing and future needs of the County's water system.
- (5) The length of mains, developed in streets, subdivisions, commercial or industrial complex, shall be based on the following principles:
  - a. The terminal point of extension shall be the property line beyond the last user to be served by the extension;
  - b. The extension shall include all services connections required to cover users to be served by the extension;
  - c. If the last user is adjacent to a roadway or easement that contains a water main, the water line shall be extended to that line to increase water pressure and water quality.

Note: Additional easements may be required by the County Engineer to provide a loop system with existing proposed extensions to future proposed water lines.

### **C. Fire Flow**

- (1) The Developer shall be responsible for contacting the Fire Marshal to determine the estimated fire flow available at the point of connection to the water system. The Developer shall submit information on the required fire flow and calculations in accordance with the submittals section to confirm the required fire flow is available. A minimum of a ten percent buffer shall be deducted from the hydrant test results prior to incorporation into the project model. The Fire Marshal may require an increase or decrease in this allowance on a case-by-case basis.
- (2) The hydraulic/fire flow model shall include:
  - a. Static condition indicating only new domestic demand.
  - b. Separate fire flow models from each hydrant to indicate each hydrant is capable of providing the fire flow demand while concurrently providing peak domestic and sprinkler demand. Adequate system design and performance information including C-factors, proposed elevations, pipe flow velocities and head losses under fire flow conditions shall be submitted to allow for a complete review of the proposed system.
- (3) The Fire Marshal, or their appointee, shall make the final decision of required Fire Flow for site specific conditions. For fire hydrants locations see the County or Town Fire Marshall and check the Water & Wastewater Extension Policy Manual.

#### **D. Needed Fire Flow Calculations (NFF)**

An estimate of fire flow required for a given structure shall be based on the following ISO formula:

$$NFF = C_i \times O_i \times (1.0 + X + P)^j$$

Where: NFF is the needed for flow in gallons per minute

$C_i$  is a Construction factor that depends of the structure under consideration

$O_i$  is an Occupancy Factor that depends of the combustibility of the occupancy

$(X+P)$  is an Exposure Factor that depends upon the extent of exposure from and to adjacent structures.

For further information on the formula and its proper application, refer to the NFPA “Fire Protection Handbook”, 18<sup>th</sup> Edition.

In all cases, the required fire flow shall not be less than the amounts listed below with greater amounts where required by the ISO equation and the State of North Carolina Fire Code tables unless otherwise modified by the Fire Marshal.

<b><u>DISTANCE BETWEEN BUILDINGS</u></b>	<b><u>NEEDED FIRE FLOW</u></b>
More than 100'	500 gpm
31' to 100'	750 gpm
11' to 30'	1,000 gpm
10' or less	1,500 gpm

The calculated (required) fire flow shall be reviewed by the County Engineer and Fire Marshal and the flows may be adjusted as determined appropriate by the Fire Marshal for site specific conditions.

### **3.02 LOCATION WITH UTILITIES**

#### **A. Easements**

Unless approved by the County Engineer, a 20 foot easement shall be obtained when crossing Private Property Owners, Electrical Transmission Feeder Lines and all other Utilities. Encroachment Agreements shall be obtained when utilizing the right-of-way of NC DOT, Railroad, and Town Streets. No permanent structure shall be constructed within these easements without prior approval from the County Engineer. No trees, large shrubs, or other obstacles shall be placed within an easement which would render the easement inaccessible by equipment. A gate, for maintenance access, shall be provided if any fence constructed is permitted crossing the easements.

## **B. Sewer Mains**

- (1) Water mains shall be laid at least 10 feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-foot lateral separation—in which case:
  - a. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18-inches above the top of the sewer; or
  - b. The water main is laid in the same trench as the sewer with the water main located at one side of a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18-inches above the top of the sewer.
- (2) Water Main Over a Sewer. The water main shall be laid at such an elevation that the bottom of the water main is at least 18-inches above the top of the sewer, unless local conditions or barriers prevent an 18-inch vertical separation—in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10-feet on each side of the point of crossing.
- (3) Water Main Under a Sewer. Both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10-feet each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

## **C. Storm Sewer and Gas Mains**

- (1) Water mains shall be of Ductile Iron Pipe at all areas where 18” clearance crossings above the storm or gas line cannot be obtained. (See STD. NO. PW-1)

Water mains shall be of Ductile Iron Pipe at all areas where 2-feet clearance crossings below the storm or gas line cannot be obtained. Install at least one joint of DIP centered under the line and backfill to 18” above the water line with washed stone. (See STD. NO. PW-1)

- (2) Parallel lines shall have a 10 ft. separation.

## **D. NC DOT Right-of-Way**

- (1) Utilities to be constructed within NC DOT right-of-way will require a NC DOT Encroachment Permit.
- (2) All distribution systems within NC DOT right-of-way shall be designed as outlined in NC DOT manual “Policies and Procedures for Accommodating Utilities on Highway Right-of-ways”.

- (3) Crossings under ditch to be 24 inches below bottom of ditch to top of pipe.  
Crossings under roadways to be 3 feet below top of roadway to top of pipe or encasement pipe.

#### **E. Railroad Right-of-Way**

- (1) Utilities to be constructed within Railroad right-of-way will require an Encroachment Permit from the Railway management.
- (2) Railroad crossings shall be perpendicular, ductile iron pipe and encased.
- (3) Crossing to be 5 feet 6 inches from top of rail to top of encasement pipe.

### **3.03 EROSION CONTROL**

All water main construction plans, regardless of project size shall include measures and/or devices to prevent soil erosion and to prevent sedimentation of streams and drainage ways. This requirement is waived for water mains in subdivision projects where the project erosion control plans includes water main construction and where enforcement of erosion control requirements is not under MCPW control. Design of Erosion and Sediment Control devices shall be in accordance with MCPW "General Construction Standards and Specifications" Section 2.14 "Seeding/Turfing and Erosion Control" and North Carolina "Sediment Control Planning and Design Manual".

### **3.04 PIPE MATERIAL**

#### **Pipe Size & Type**

Pipe Type	Pipe Size
DIP Ductile Iron Pipe, PC 250	18" & larger
DIP Ductile Iron Pipe, PC 350	12" & smaller
PVC C-900, PC 235 – DR 18	4" to 12"
PVC C-900, PC 200, DR Fusible	4" to 12"
PVC C-905, PC 200 – DR 21	14" to 36"
PVC C-909, PC 200 – DR 25.48	6" to 12"
SDR-21, PC 200, ASTM D2241	2" to 10"
PEP Tubing, PC 200	1" & 2"
SP Steel Pipe, 35,000 psi (Encasement)	all sizes
HDPE, DR-9, 250 psi	all sizes

- a. Encasement is required for all main and service crossing on Interstate Standards roads.
- b. Encasement is required for all mains crossing under non Interstate Standards roads.
- c. Encasement is not required for roads with 2,000 vpd or less.
- d. Encasement is required for all Railroad crossings.

#### **A. Ductile Iron Pipe**

All ductile iron pipes shall be designed as per ANSI/AWWA C151/A21.50. Pipe wall thickness shall conform to ANSI/AWWA C150/A21.50. Pipe up to and including 12 inch diameter pipe shall be Pressure Class 350 (min.), while pipe greater than 12 inch diameter shall be at least Pressure Class 250. The Engineer may require heavier class pipe on a case-by-case bases.

Pipe joints shall be of the push-on type with rubber gaskets as per ANSI/AWWA C111/A21.11. Mechanical or special joints may be used as project requirements dictate or as required by the Engineer. Pipe lining shall be cement-mortar, on the interior, with an external coat of bituminous material, all in accordance with ANSI/AWWA C104/A21.4. Where restrained joints are indicated Mega-Lugs or Grip Rings shall be used.

The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.

Ductile iron pipe shall be manufactured by U.S. Pipe, American, or Clow, and shall be furnished in 20 foot and 18 foot lengths.

#### **C. PVC Pipe- C-900 , C-905 & C 909**

PVC pipe shall be rigid polyvinyl chloride with integrally formed, factory fabricated bell with "slip" joints rubber gaskets conforming to AWWA C-111. It shall be suitable for all conditions imposed by Plan locations and for a maximum working pressure of 200 psi. Pipe shall be Type 1, Grade 1, made from clear virgin material and shall conform to the requirements of ANSI/AWWA C-900. All pipe shall bear the National Sanitation Foundation Seal of Approval for potable water, the manufacturer's name, and class of pipe.

Provision must be made for expansion and contraction at each joint, through the rubber gasket and pipe bell. Where restrained joints are indicated Mega-Lugs or Grip Rings shall be used.

Contractor shall not use pipe that is brittle or sun bleached which shall compromise its use.

Pipe to conform with ANSI/AWWA C-900 for C-900, DR-18 ; C-905, DR-21; or C-909, DR 25.48 pipe within municipal boundaries and extra-territorial jurisdiction, and within residential subdivisions, shopping centers and industrial complexes within rural areas, for all new construction.

#### **D. PVC Pipe-SDR 21**

All PVC SDR 21 pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound per ASTM D1784. The pipe shall be manufactured in strict compliance with ASTM D2241, consistently meeting and/or exceeding the Quality Assurance test requirements of this standard with regard to pressure rating, material, workmanship, burst pressure, flattening, impact resistance, and extrusion quality. The pipe shall be manufactured in the USA, using domestic materials. All pipes shall be stored indoors after production at the manufacturing site until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications.

Use SDR-21 pipe for 10 inches and less in rural areas which are less populated and C-900 pipe for 12 inches and less in urban areas unless special needs require other type as approved by the Engineer.

#### **E. HDPE , High Density Polyethylene, Pipe**

HDPE pipe for directional drilling shall be DR-9, 250 psi, and sized to have the inside diameter of the HDPE pipe to be one size larger than the inside diameter of the connection water main. Connection of HDPE & PVC or ductile iron pipe shall be level and made to prevent binding of HDPE. All pipe shall be conform to ANSI/AWWA C906 and C901. Pipe to conform to ASTM D2737.

HDPE after directional drilling should be allowed to contract (release) for 30 days after which connection shall be made to three full lengths of DIP, restrained with mechanical joints. A valve shall be placed between the first and second joint of DIP at each end of the HDPE.

#### **F. Steel Encasement Pipe**

Encasement pipe for installation under highways and railroads shall be 35,000 psi pipe conforming to ASTM A139. Encasement pipe shall conform to DOT specifications for pipe laying for highway crossings and to AREA specifications for railroad crossings. The pipe shall be furnished with a bituminous coating on the outside.

- (1) Carrier Pipe – PVC or DI (Same as pipe material on line segment)
- (2) Spacers – Steel, epoxy coated “spiders” shall be provided. Provide one spacer in the center of pipe and one spacer on each end of the same pipe stick.
- (3) Carrier Pipe shall be installed using boltless restraining gaskets. Boltless restraining gaskets shall be “Field-Lok”, “Fast-Grip”, “Gripper Gasket” or approved equal.

### **3.05 FITTINGS**

### **A. Ductile Cast Iron Fittings**

Ductile cast iron fittings shall conform to the requirements of ASTM A21.10, with mechanical joint ends conforming to ASTM A21.11, except that material and manufacturer shall conform to ASTM A339, Grade 80-60-3. All fittings shall be bituminous coated and cement lined as required for pipe. Where flanged ends may be required, flanges shall conform to applicable requirements of ANSI B16.1 and ANSI B16b. Minimum class shall be Class 350 pipe. No push on joint ends will be allowed.

Ductile Iron Pipe must be used in areas where pipe length is less than 4 feet, between fittings, etc.

### **B. Gaskets**

Gaskets for pipe and fittings shall be continuous ring of rubber material compounded to resist deterioration and of a texture to assure a permanent and watertight seal. They shall have smooth surfaces, free from pitting, blisters, porosity or any other defects. Gaskets shall conform to the requirements of ANSI/AWWA C111/A21.11.

Gasket lubricant shall be a potable hydrogenated vegetable oil, insoluble in cold water, non-toxic, shall not support the growth of bacteria, and shall not impart taste or odor to the water. It shall not contain detergent soaps, organic solvents or other deleterious ingredients and shall have no deteriorating effects on the gaskets. The lubricant shall be semi-paste, easily applicable, readily adherent to the inside of the bell and shall remain in a usable state throughout the range of temperature in which pipe is normally installed.

### **C. Iron Fittings**

Iron fittings shall be manufactured in accordance with ANSI/AWWA C-110/A21.10, latest revision and addendum. The fittings shall be tested and the manufacturer shall provide certified test results upon request by the Engineer. This testing shall include hydrostatic proof testing of the fittings.

All fittings shall be cast iron or ductile iron and shall have a minimum working pressure rating of 250 psi and a minimum iron strength of 25,000 psi. Iron fittings shall be all-bell mechanical joint conforming to ANSI/AWWA C-115/A21.15-05. On all fittings Mega-Lugs or Grip Rings shall be used. Male compression restrained joints to be used on 2 inch PVC.

All fitting interiors shall be cement mortar lined, with bituminous seal cast in accordance with ANSI/AWWA C-104/A21.4 and the outside shall be bituminous coated.

## **3.06 VALVES**

## **A. Valve Location**

Valves shall be installed on all branches from mains and on hydrant branches according to the following schedule:

- 3 valves at cross intersections
- 2 valves at tee intersections
- 4 valves at cross intersections near water towers
- 3 valves at tee intersections near water towers
- 1 valve on hydrant branches
- 1 valve at “stub outs” for future extensions
- 1 valve at change in pipe size
- 1 valve at each end of directional bore line
- Additional valves may be required as needed

Main line valves on straight runs between intersections shall be spaced at interval distances not to exceed the following:

### **For Urban Areas**

<b><u>MAIN SIZE</u></b>	<b><u>MAXIMUM SPACING</u></b>
6”	600’
8”	800’
12”	1,200’
16”	1,600’

### **For Rural Areas**

<b><u>MAIN SIZE</u></b>	<b><u>MAXIMUM SPACING</u></b>
4”	1,000’
6”	2,000’
8”	2,000’
12”	3,000’
16”	3,000’

Main line valves should also coincide with fire hydrants and must be within fifty feet of the nearest hydrant. Valves 4-feet and deeper should have operation nut extended to one foot from surface. See STD. NO. PW 3 for detail.

## **B. Gate Valves**

### **12 inch and Smaller:**

Gate valves 12 inch and smaller shall be of the resilient wedge type conforming to ANSI/AWWA Standard C-515. They shall be designed for a working pressure of 200 psi. The valves shall be open-left (counter clockwise), non-rising stem, gray cast iron or ductile iron body, with O-ring seals and a 2 inch square operating nut. Extension stems shall be furnished when depth of bury places operating nut is in excess of four feet below finished grade.

#### **16 inch and Larger:**

Gate valves 16 inch and larger, may be the horizontal gate type or butterfly type and shall be used for all main line in sizes 16 inches through 24 inches.

### **C. Tapping Valve**

All tapping valves shall conform to the Standard Specification for gate valves, 12 inches and smaller, as noted above, except that the inlet end shall be flanged, faced and drilled per ANSI B16.1 for 125 lb. standard. The outlet end shall be of the mechanical joint type capable of receiving a standard tapping machine.

Resilient Wedge Gate Valves to conform to ANSI/AWWA C-505 – shall be Clow, Mueller or Kennedy.

### **D. Butterfly Valves**

Butterfly valves shall be used in lieu of gate valves for water mains 16 inches or greater, unless pressure dictates a need for higher pressure valve.

Butterfly valves shall meet or exceed ANSI/AWWA C-504 for disc seat type valves. Iron valves bodies shall conform to ASTM A-126. Valve disc shall be cast bronze or cast iron with bronze or stainless steel seating surfaces. The disc shall have adjustable stops preset by the factory and the seals shall be natural rubber. Butterfly valves shall be furnished with buried service actuators with 2" square operating nuts and open by turning counter clockwise. Extension stems shall be furnished when the depth of bury places the operating nut in excess of four (4) feet below finished grade. Butterfly valves shall have mechanical joint ends conforming to ANSI/AWWA C111/A21.11. Butterfly valves shall have a design working water pressure of 150 psi and be hydrostatically tested to 300 psi. Valves shall be Mueller, Kennedy, Pratt, or equal.

### **E. Valve Markers**

Valve Markers are to be installed in rural areas, near the right-of-way line, to better identify their location for all other valve locations. In urban areas, valve markers are to be installed only as recommended by the Engineer. Valve markers shall be placed 1-foot inside right-of-way line or property easement. See STD. NO. PW 4 for detail.

For Valve Marking and Valve Box Cover protection provide a concrete protector ring. See STD. NO. PW 5 for detail.

#### **F. Valve Boxes**

Valves shall be set at locations shown on the plans with care being taken to support the valve properly and to accurately position the valve box over the operating nut of the valve. Valve boxes shall be set on brick for stability and not sit directly on the valve or water main. Where located within paved areas, the box shall be adjusted to finished street grade and a concrete pad (2 ft square and 2 inch thick) shall be placed around the valve box with the valve box protruding above the concrete a distance equal to the final pavement thickness. When valves are located in street right-of-way, but out of pavement, the boxes shall be adjusted to finish grade and a concrete block shall be placed around the box one inch above the street right-of-way grade. See STD. NO. PW 6 for detail.

All valve boxes shall be of the adjustable type. Valve boxes shall be cast from close-grained gray iron, in three pieces consisting of a lower base piece, upper part and cover. The lower base piece shall be flanged at the bottom to fit around the valve and shall also be flanged on the lower end and of such size as to telescope over the lower part with upper end cast on the upper surface in raised letters the word "WATER". Valve boxes shall be painted prior to shipment with a coat of protecting asphaltic paint.

No PVC pipe shall be used for valve box extension.

#### **G. Air Releases and Combination Air Valves**

Combination Air Valves shall be provided at high points on all 12 inch and larger water mains where the change in vertical grade crest to sag crest is 2 feet or greater. An Air Release Valve shall be provided at high points on 2 inch and 8 inch water mains where air cannot be adequately released from the main through service connections.

On pumped lines or in any other application where the potential for water column separation exists, the Engineer shall evaluate the need for Combination Air Valves and shall recommend specific valve configurations for approval.

Air release valves shall be installed within a wet well valve box.

Air release valves shall be contained within a concrete vault with a drain to daylight or other means to ensure that the vacuum relief port cannot allow outside water to enter the waterline.

Air valves shall be equivalent to ARI, or approved equal, and conform with ANSI/AWWA C-512. See STD. NO. PW 7 for detail.

## **H. Blow Off Assembly**

All transmission mains 12 inches and larger must be designed such that they can be dewatered completely within four hours through blow off assembly or a fire hydrants. Dead end lines 4" and less shall be terminated with a 2 inch blow off valve and lines 6" and larger are to be terminated with a fire hydrant. Flushing sites shall have adequate drainage areas. See STD No. PW- 8 for Detail.

## **3.07 HYDRANTS**

### **A. Hydrant Installation**

Hydrants shall be set plumb, properly located with the pumper nozzle facing the closest curb of a fire lane or street, but not a parking space. Hydrant tees shall be used. Restraining couplings are to be installed. A minimum of four cubic feet of #57 stone shall be placed around the drains. The backfill around the hydrants shall be thoroughly compacted. Hydrants shall be placed 1-foot inside the back of right-of-way or property line. Fine grade shall be to the barrel line. See STD. No PW- 9 for detail.

No one except MCPW personnel, authorized agents of MCPW and qualified Fire Department personnel are authorized to operate any of the distribution system fire hydrants. This requirement in accordance with N.C. Register 10 NCAC 10D. 1066 (b) (7).

### **B. Hydrant Types**

Fire hydrants shall be of the compression type meeting ANSI/AWWA C502 standards, designed for a minimum working pressure of 150 psi and a hydrostatic test pressure of 300 psi with the valve in both the open and closed positions.

All hydrants shall be equipped with two 2-1/2 inch nozzles and one 4-1/2 inch pumper nozzle. Each nozzle shall be bronze with cast iron caps secured thereto with a suitable steel chain. Nozzles shall have National Standard threads.

The hydrants shall be open-left and equipped with a pentagon-type operating nut (National Standard) measuring 1-1/2 inches from point to flat. Hydrants shall be of the "dry top" type with the upper rod threads completely enclosed in a sealed grease or oil chamber, equipped with "O" ring seals and a Teflon thrust bearing.

The hydrants shall have a 6 inch shoe or boot, mechanical joint. Hydrants shall have bronze to bronze threads provided between the hydrant seat or seat ring and the seat attaching assembly. The hydrant shall be of the "safety" type so that, if the upper

barrel is broken off, the hydrant valve will remain closed and reasonable tight. All hydrants shall be furnished with barrel and stem extensions as required by the final field location to provide a nominal minimum bury of three feet, six inches (3'-6"), or greater, if indicated on the Drawings.

All hydrants shall have a thrust block behind the hydrant, below the weep holes allowing the weep holes to still be operational.

Hydrants off 12" mains and larger or as specified by the Engineer, shall have 5-1/4 inch barrel diameter.

Hydrants shall be Mueller "Super Centurion", Clow "Medallion", or equal.

### **3.08 TAPPING EXISTING WATER MAINS**

#### **A. Tapping Sleeves**

Tapping sleeves shall be used on all taps greater than 4 inches. Tapping sleeves shall be a two piece type, stainless steel suitable for bolting and air testing. The body is to consist of a gasket of Virgin SBR rubber compound. Tapping sleeves as manufactured by Mueller, Romac, JCM and Smith-Blair are acceptable. See STD. NO. PW 10 & 11 for detail.

Tapping Sleeves shall meet the appropriate length listed in the table below:

<b><u>Main and Tap (inches nominal)</u></b>	<b><u>Length (along run)</u></b>
6x6, 6x3, 6x4, 6x2	18"
8x2, 8x3, 8x4, 8x6	19"
8x8	21"
10x2, 10x3, 10x4, 10x6	19"
10x8, 10x10	23"
12x2, 12x3, 12x5, 12x6	19"
12x8	21"
12x10, 12x12	25"

Sleeves shall meet all the requirements of ASNI/AWWA C110/A21.10 and C111/A21.11. Tapping sleeves shall have a full circumferential gasket. For tapping sleeves with an outlet diameter greater than 12 inches, the sleeve shall have an outlet seal gasket. Lubricate pipe and face of gasket with water or soap-water. Do not use petroleum based products such as grease or pipe lubricant.

When installing, the existing main shall be carefully and completely cleaned prior to installing the tapping sleeve or saddle. All surfaces of the existing main encompassed by the sleeve, along with the inside of the sleeve and the inside of the tapping valve, shall be disinfected during installation by swabbing with a chlorine solution or dusting with calcium hypochlorite (HTH) powder. Once these surfaces are

disinfected, the Contractor shall not allow dirt, mud, trench water or any other contaminants to come in contact with these surfaces.

Once the tapping sleeve and valve are installed on the main, a pressure test shall be performed by applying 100psi compressed air to the test port for a period of at least 15 minutes, with no drop. During this period, all joints shall be mopped with a soap-water solution to locate leaks. This test shall be performed in the presence of the Engineer or his representative.

Upon satisfactory completion of the installation and pressure testing of the tapping sleeve and valve, the existing main shall then be tapped using a tapping device equipped with a pilot drill and shell type cutter which retains the pipe coupon. Once the tap is complete and the tapping machine removed, the tapping valve shall be cleaned of any cuttings and then kept plugged until the water main is installed. A thrust block shall be placed behind the wet tap with plastic wrap between the pipe and thrust block.

## **B. Corporation Stops**

Corporation stops shall be designed and manufactured in accordance with ANSI/AWWA C800 latest revision. Corporation stops shall be equipped with an AWWA standard tapered thread on the inlet end and a compression connector on the outlet end for connection of plain end copper tubing. The stops shall be fully shop tested for leaks with air pressure under water. The stop shall have a minimum rated working pressure of at least 300 psi, with a safety factor of at least 2 times the rated working pressure. No 'ground key' corporations shall be used. The corporation stops shall be as manufactured by Mueller, Ford, or equal.

## **C. Service Tubing**

PE Service Tubing – PE Service Tubing shall meet ANSI/AWWA C-901 and be clearly marked with the following data: Nominal size, rated operating pressure at 73.4 degrees F, type of (water service pipe), material designation code, Date Code – month, year, day, Manufacturer's brand name, National Sanitation Foundation logo indicating approval for potable water usage and compliance with ASTM specifications, plant location code, and ASTM D-2239 approval.

## **D. Water Meters**

Water meters for individual residences and small commercial unit services shall be displacement disc type with magnetic drive and hermetically sealed register and radio read. The meter shall conform to the design and accuracy requirements of ANSI/AWWA C706. Registers shall be straight reading with units of gallons. Meters shall have male threaded ends and copper alloy cases and shall have a

minimum warranty of one (1) year installation to be free from defects in workmanship and materials. Meters for normal single family residential service shall be  $\frac{5}{8}$ " x  $\frac{3}{4}$ " with a safe operating capacity of 20 gpm. Separate meters are required for irrigation to separate from domestic water. Meters for other services shall be of a size requested and approved by the Engineer. Manufacturer of meters shall be Badger unless otherwise approved by the Engineer. See STD. NO. PW 12 & 13 for detail.

For a 2 inch Water Meter Service see STD. NO. PW 14 for detail.

For a 3 inch and larger Water Meter Service and Vault see STD. NO. PW 15 for detail.

Multiple occupancy building may be master metered or the individual units metered separately. Where "gang" meters are installed, permanent placards shall be provided inside the meter box to indicate the unit served by each meter. The only exception to this metering requirement shall be in the case of building fire sprinkles systems, where such services shall be equipped with a detector meter on the backflow prevention device. Where irrigation or other service connections are requested a separate meter shall be installed.

Multiple meters on branched services are acceptable for multiple occupancy buildings, providing they conform to the following table.

#### **E. Master Meters**

Master meters may be permitted to serve single ownership, single lot properties in the following categories:

- i. Apartments/Condominiums
- ii. Hotels/Motels
- iii. Hospitals
- iv. Warehouses/Industrial Buildings
- v. Schools
- vi. Mobile Home Parks
- vii. Shopping Centers
- viii. Churches
- ix. Rest Homes

Plans for these properties shall meet all building and fire code requirements. All water mains, valves, and fire hydrants shall meet the County's standards and specifications. Master meters shall be installed in vaults that have positive drainage provided and sump pump or shall be constructed above ground within an insulated enclosure.

Two inches and larger Domestic Services Meters shall be Compound Type if approved by the Engineer. Irrigation Meters may be Compound or Turbine.

## **F. Check Valves**

To be 1 and 2 inch Ford HHS 31-323 or equal.

## **G. Meter Boxes**

Meter boxes shall be rectangular with minimum nominal dimensions of 21-3/8" x 14-7/8" x 12" (l.w.d.). Lids shall be labeled "WATER METER", containing a cast iron lid and reader holes. Boxes may be plastic except for traffic bearing installations, which shall be cast iron. Meter boxes shall have at least a 3' allowance from any obstructions. All meter boxes shall have at least 4" of washed stone installed to allow for proper drainage. Meter Box with Lid provided by Century, NDS, DFW or equal. See STD. NO. PW 16 for detail.

## **H. Service Saddles**

Service Saddles shall be wide body style for PVC water mains (Ford S-70, Mueller H-134 or equal) or double strap style for ductile iron water mains (Ford S-90, Mueller BR2B or equal). Body shall be stainless steel, bronze or brass with O-ring seal, manufactured to meet AWWA C800. Saddles shall be used for 1", and 2" service outlet diameter types. See STD. NO. PW 11 for detail.

## **I. Dual Branch Assembly**

Dual Branch Assembly to be used for each building lot where irrigation is anticipated. The County Engineer shall determine if dual or single assembly is needed. The assembly to be 1 inch with 3/4 inch outlet, Ford UV B13-42W, or equal. See STD. No. PW 13 for detail.

### **3.09 CROSS CONNECTION CONTROL**

When it is determined that a backflow prevention assembly is required for the protection of the public system, as required by AWWA Standard C 511 for a Double Check Valve and C 512 for a Reduced Pressure Zone, then the developer shall be required, at the developer's expense, to install an approved backflow prevention assembly at each service connection, to test immediately upon installation and thereafter at a frequency as determined by the MCPW, to properly repair and maintain such assembly or assemblies and to keep adequate records of each test and subsequent maintenance and repair, including materials and/or replacement parts.

#### **A. Double Check Valve (DCV)**

For moderate hazards, a Double Check Valve (DCV) shall be required. A moderate hazard is one that, if introduced into the public water supply system could be a nuisance to water customers but would not adversely affect human health. Moderate

hazards include, but not limited to, commercial services, fire sprinklers, lawn sprinklers, etc. See STD. NO. PW 17, PW 18, PW 19, PW 20 for detail.

#### **A. Reduced Pressure Zone (RPZ)**

For severe hazards, a Reduced Pressure Zone (RPZ) shall be required. A severe hazard means an actual or potential threat of contamination of a physical, chemical, biological, pathogenic or toxic nature to the public water system to such a degree or intensity that there would be a danger to health. Severe Hazards include, but not limited to, lawn sprinklers with chemical injection and/or booster pumps, fire sprinklers with chemical added, car wash, laundries, swimming pools etc.,. See STD. NO. PW 21, PW 22, PW 23, PW 24 for detail.

All yard sprinklers or any fire-line equipment with a Fire Department Connection (FDC) assembly shall provide a Reduced Pressure Zone (RPZ) backflow preventers to be installed above ground to ensure positive drainage. The installation shall include a heated, insulated enclosure such as a “Hot Box” or approved equal. On fire services, a touch pad type meter shall be provided for reading the detector meter. Double Check Valve (DCV) backflow preventers may be installed in an underground vault provided adequate drainage and access is provided to ensure proper testing and maintenance can be easily conducted.

All DCV and RPZ shall be approved by Moore County Public Works, Operator in Responsible Charge (ORC).

DCV and RPZ must meet American Society of Sanitary Engineering (ASSE) standard and carry ASSE seal or is on the University of Southern California approval list.

See the Moore County Cross Connection Ordinance for additional information.

### **3.10 METER VAULT**

Meter Vaults are used for the primary purpose of housing Pressure Reducers, Flexible Connections, Water Meters and Strainers. The vault can contain supplementary items such as ½ HP Stainless Steel Submersible Sump Pumps, Model # 3050 or equal, two 4 inch “goose neck” vent pipes, Polypropylene Plastic Steps and Aluminum Door(s) AASHTO H-20 wheel load, JD-AL-H2O, Bilco or equal, all contained in or on a 4,000 psi reinforced concrete box. See STD. NO. PW 15 for detail.

The vault shall have a valve at each outside end of the vault to shut off the meters and for maintenance. A by-pass line parallel to the vault shall be installed with a valve to close if the meters are in use and to open if meters are not in use. The top of the vault should be approximately 8 inches above the natural ground surface and should be coated on the underground outside surface with exterior water proofing.

### **3.11 TRENCH EXCAVATION**

Water main trenches shall be excavated to such depth that the pipe will have a minimum cover of at least 3 feet as measured from final, finished grade, based on the approved typical sections and/or grading plans to the crown of the installer pipe. In general, installation depth shall be limited to a maximum of 5 feet in depth unless it conflicts with other subsurface structures. See STD. NO. PW 25 for detail.

Trench width shall be a minimum of 16 inches plus the outside diameter of pipe barrel up to 10" and a maximum of 24 inches plus the outside diameter of pipe barrel from 12" and larger, unless trenching is approved.

Where water main trench excavation is in rock, the rock shall be excavated to a minimum depth of 6 inches below the bottom of the pipe. This space shall be filled with selective material approved by the Engineer.

In trenches where water is present or where dewatering is required, the trench bottom shall be stabilized with selective material approved by the Engineer. When material of poor supporting value (i.e. "muck") is encountered in the trench, it shall be removed and replaced with selective material approved by the Engineer.

All water main trenches shall be protected from entrance of surface water. Any water observed in the trench shall be promptly removed by pumping, or other means, provided that water disposal is directed to suitable erosion control devices to prevent deposition of sediment into nearby streams, ponds, etc. The Contractor shall use all means necessary to prevent the entrance of water, including the construction of temporary berms or dikes.

### **3.12 PIPE INSTALLATION**

#### **A. General**

All water main pipes shall be clean before installation. Any dirty pipe shall be thoroughly swabbed by the Contractor. Pipe showing evidence of oil or grease contamination shall not be used.

Pipe laying and jointing shall be accomplished in strict accordance with the recommendations of the pipe manufacturer. Care shall be taken during pipe installation so as not to exceed the maximum joint deflection.

Open ends of the pipe shall be plugged at all times that pipe laying is not in progress.

Bell ends shall generally face the direction of flow source. Where water mains are installed on an appreciable slope, the Engineer may require that the bell ends face upgrade.

The barrel of the pipe shall bear uniformly upon a firm and stable flat bottom trench at all times. Bell hole shall be excavated such that the pipe rest uniformly on its entire barrel length.

## **B. Tracer Wire**

Tracer wire shall be installed near, not adjacent to, all water mains, hydrant laterals and service laterals. Tracer wire shall be number 12 gauge, color blue, rated underground with a breaking strength of 450 lbs.<sup>+</sup> and a coating of 30 mils. After installation, the Contractor is responsible for the testing of the tracer wire in the presence of the Engineer or a designee.

All spliced or repaired wire connections in the tracer wire system shall be made using a Wing Nut Wire Connector (for two to four number ten wires), or approved equivalent, and made waterproof using an approved buried service wire closure. The buried service wire closure shall be Frame Gel Closure or equivalent.

Detectable Warning Tape shall be installed from 18 inches to 24 inches above the pipe line.

## **C. Thrust Restraint**

Thrust restraint for water mains shall be provided at all tees, bends and plugs. Restraints shall be restrained type mechanical joint and/or concrete blocking. Concrete thrust blocking shall be poured in place. The bearing area for thrust blocks shall be based on the required test pressure of 200 psi and a field determination of the load bearing capacity of the soil. Conservative estimates of soil load bearing capacities by experienced and qualified inspectors are normally allowed. However, analysis may be required by the Engineer. See STD. NO. PW 26 for detail.

For lines that end with a valve for future extension, there shall be added to the valve one full pipe stick, plug and concrete blocking.

## **D. Unfinished Streets**

Where main extensions are laid in unfinished streets, the developer shall be fully responsible for damages to the main and all fixtures and appurtenances, such as hydrants, gate valve boxes, blow-off boxes, etc., including the location thereof. If, after the mains are laid, the surface grade is lowered with the result that the required minimum cover of the mains, fixtures, or appurtenances is not maintained, then the developer shall pay for cost of lowering the mains to the structural level required to correct this deficiency. This responsibility shall remain in force until such time as the street is structurally complete.

### **3.13 BACKFILLING**

#### **A. General**

Backfilling shall be completed as soon as possible, so as to minimize the length of time that the trench or any part thereof is left open. Material classification for backfill materials as may be noted hereinafter shall conform to the Engineer's requirement.

#### **B. Backfilling**

All trash, forms, debris and other foreign material shall be cleared from around all pipes and structures before backfilling. The pipe shall be backfilled with suitable materials. The initial backfill to a point 12 inches above top of the pipe shall be placed in shallow 6 inch layers, individually compacted, with emphases on the “hunching” area (up to the spring-line of the pipe). See STD. No. PW 25 for detail.

#### **C. Final Backfill**

The remaining or final backfill for all pipe materials shall be suitable material. No rocks, boulders, or stones shall be included in the backfill material for at least 2 feet above the top of the pipe. In non-traffic areas, the backfill shall be placed in lifts not exceeding 12 inches and compacted to 90% of maximum dry density per AASHTO T-99. In traffic areas the final backfill shall be placed and compacted in 6 inch layers, and compacted to 95% of maximum dry density per AASHTO T-99 to a point 12 inches below subgrade. The top 12 inches shall be compacted to 100% of maximum dry density (AASHTO T-99).

Where deemed necessary, the Engineer may require compaction test on any or all lifts of backfill placed in trenches under roadways. The cost for such test shall be borne by the Contractor.

### **3.14 PRELIMINARY FILLING AND FLUSHING**

No valve shall be operated without giving a minimum 24 hours' notice to the MCPW. No Contractor or other non-MCPW personnel shall at any time operate any valve. MCPW must be contacted for information on purchasing water, account setup for construction water, and for approved hydrant meter arrangements.

The Contractor, first, shall pump dry and dispose of all extraneous ground water and other sand gravel and foreign objects within the water main. The new or empty water mains now shall be slowly filled with water at a rate that will allow complete evacuation of air from the line.

Each valve section of the completed main shall be flushed prior to chlorination as thoroughly as possible with water pressure and outlets available. If no hydrant is provided at the end of the main section, a tap shall be installed at the main section extremity, large enough to develop a velocity in the main of at least 2.5 fps. The flushing operations shall be done after the pressure test has been made. Each valve section of the newly laid pipe shall be flushed separately. Flushing sites shall have adequate drainage and shall be approved by the Engineer. The Contractor shall provide hoses, pipe, etc. to divert water from flushing operations into drainage ways to avoid damage to yards and erosion.

NOTE: Pigging to be at the discretion of the Engineer.

### **3.15 HYDROSTATIC TESTING**

No valve in the existing water system shall be operated by any party other than MCPW employees.

The line shall be tested to a pressure of 200 psi for a duration of 24 hours. The pressure gauge used in the hydrostatic test shall be calibrated in increments of 5 psi or less. At the end of the test period, the leakage shall be measured with an accurate water meter, supplied by the contractor.

No pressure pipe installation will be accepted until leakage is less than the number of gallons per hour for each section tested, as determined by the following formula:

$$Q = \frac{LD}{12,670}$$

Q = Allowable leakage, in gallons per hour

D = Nominal diameter of the pipe, in inches

L = length of pipe tested, in feet

All visible leaks at pipe joints, services, and at any appurtenances are to be repaired regardless of the amount of leakage. After testing, remove service line from testing point.

Pressure testing is the responsibility of the Contractor. All pressure tests must be witnessed by the Engineer, or designee, for approval.

Water for testing and blow-off may be obtained from existing water main. The contractor is responsible for any cost of water used during testing.

### **3.16 DISINFECTION**

All new, cleaned or repaired water mains shall be disinfected, by the Continuous Feed method, in accordance with AWWA Standard C651.

Chlorination of a completed line shall be carried out in the following manner:

- (1) Taps will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. The taps shall be strategically located so as to allow High-Test Hypochlorite (HTH) solution to be fed into all parts of the line.
- (2) A solution of water containing HTH (65%) available chlorine shall be introduced into the line by regulated pumping at the control valve tap. The solution shall be of such concentration that the line shall have a uniform concentration of 50 ppm free chlorine immediately after chlorination. The chart below shows the required quantity of 65% HTH compound contained in solution in each 1000 feet of line to produce the desired concentration of 50 ppm.

<b>POUNDS OF HIGH TEST HYPOCHLORITE (65%) PER 1000 FEET OF LINE FOR 50 ppm</b>	
<b><u>PIPE SIZE</u></b>	
2"	0.10
4"	0.42
6"	0.94
8"	1.68
10"	2.62
12"	3.77
16"	6.70

- (3) The HTH solution shall be circulated in the main by opening the control valve and systematically manipulation hydrants and taps at the line extremities. The HTH solution must be pumped in at a constant rate for each discharge rate in order that a uniform concentration will be produced in mains.
- (4) If at any time, during the first three hours, the hypochlorite solution drops below 50 ppm, the flow shall be stopped; chlorination equipment shall be relocated at the head of the slug; and, as flow resumes, chlorine shall be applied to restore the free chlorine to not less than 50 ppm.
- (5) As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.
- (6) After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed, by the Contractor, from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than 2 ppm. Chlorine residual must be verified using an EPA approved method utilizing the chemical DPD, by the Contractor, in the presence of the Engineer or representative.

### **3.17 BACTERIOLOGICAL SAMPLING**

Free residual chlorine after 24 hours shall be at least 10 ppm, or the Engineer will require that the lines be re-chlorinated.

Flushing of lines may proceed after 24 hours, provided the free residual chlorine analysis is satisfactory. Flushing shall be continued until a check, by the Contractor with an EPA approved method utilizing the chemical DPD, shows that the lines contain only the normal chlorine residual of 2ppm. Chlorine residual shall be checked in the presence of the Engineer or representative before bacteriological samples are taken. The flushing operation shall be monitored at all times by the Contractor.

Within 24 hours after flushing is complete, the contractor shall collect samples in the presence of the Engineer, or designee, for bacteriological analysis testing by an independent laboratory approved by the NC Department of Environment & Natural Resources. The sampling points shall be identified on the Record Drawings and the sample ID indicate. Samples shall be taken every 1,200 feet, at the end of the line and on each branch. The Engineer or representative shall observe the collection of samples. Copies of the results shall be mailed directly to the Project Engineer, County Engineer, and the Town Engineer.

In the event that three successive bacteriological tests fail, that section of the main shall be re-chlorinated by the Contractor and new test performed prior to moving to the next section of the main.

No new water lines may be placed into service until such time as final approval to place into service has been granted by the County, Town, Project Engineers and NC DENR. Services will not be granted until all construction punch list items, submitted approved record drawings in accordance with this manual, submitted all required certifications, and successfully completed all testing and inspection requirements.

### **3.18 OPERATION OF EXISTING VALVES**

No valve shall be operated by any party other than MCPW. This includes the operation of tapping valves installed as part of the improvements.

New water mains valves shall remain off unless filling or flushing operations are under way. No more than one valve shall be opened at any time between the new and existing mains. Valves shall be closed immediately upon completion of filling and flushing operations and shall remain closed until the new mains have been accepted by MCPW.

### **3.19 WATER USE DURING CONSTRUCTION**

The Contractor shall make arrangements with the MCPW for water to be used for the filling, testing, flushing, etc. of newly installed water mains. All work requiring water shall be carried out in a manner, which will minimize the volume of water required. MCPW will furnish water equal to two times the water main volume. If lines have to be filled three or more times the Contractor will purchase the water at bulk prices.